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June 22, 1959

Dear Dan:

Attached is a copy of the Environmental Tests for System 4, Serial No. 107.

Sincerely,

Jack

Jack

Enclosure -
CMCC Doc. No. 162x5. 8 (Copy 1)

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ENVIRONMENTAL TESTS

SYSTEM 4, SERIAL 107

23 February through 6 March 1959

CMCC Document No. 162X5.8
Copy 1 of 7 Copies

(This document contains a total of 16 pages,
including this title sheet.)

ABSTRACT

This report describes the environmental tests conducted on Serial 107 of System 4. The tests were conducted in the test chamber leased from Litton Industries, Beverly Hills, California, during the period 23 February through 6 March, 1959.

The test procedures and test equipment were essentially the same as those used in environmental tests of the previous models of System 4.

Except for minor malfunctions noted herein, over-all performance of the system was very good. Three environmental test runs were made. Since flight tests and field operations of the previous systems have validated the environmental test results, no flight-test program is scheduled for Serial 107.

It should be noted that the test chamber at Litton Industries has no provision for temperature control, and for this reason the ambient temperatures during environmental tests are always higher than those encountered in the operating environment of System 4. Although temperature problems sometimes occur during the tests, there have been no heat problems under actual operating conditions in the field.

1. Introduction

The test equipment and general procedures used in environmental tests of System 4, Serial 107, were the same as those used in previous tests on Serial 104, 105, and 106. These are described in the environmental test report for Serial 104 (CMCC Document No. 162X5. 3).

The tests described in this report were conducted at the leased environmental test chamber of Litton Industries, Beverly Hills, Calif. Environmental tests were conducted by personnel of the Field Engineering organization. The system was delivered at the Litton facility on 23 February and initial turn-on occurred on 24 November. The first test run was made on 27 February and the last test on 4 March. Total operating time at altitude was approximately 18 hours.

Because the flight tests of Serial 105 had validated the results of environmental tests of that system, no flight tests were scheduled for Serial 106 or 107. However, three environmental test runs were made instead of the two runs made with Serial 104 and 105. Before each high-altitude test, a sea-level check was made on the receivers to make certain the performance of all units was satisfactory.

2. Summary of Test Results

25X1D

There were no major equipment failures until the third test run on 4 March when the -1610-volt power supply failed, [redacted] to become inoperative. The camera motor also failed early in this run but since more than half the film had been exposed in the two previous runs, this final test was completed without the camera operating.

As was the case with previous systems, the receiver sensitivites were affected somewhat by temperature changes. This condition is the result of change in operating conditions of the transistor regulators at higher temperatures. However, readjustment of the power supplies corrected this condition in all cases.

Because of the ground loops between the test rack and the system when it is installed in the environmental chamber, comprehensive tests

of the [redacted] were not possible. 25X1D
(This condition also existed in the previous environmental tests.) However, operation of the crystal-video receivers was satisfactory in the laboratory.

Tests of the programmer audio and video logic circuits indicated normal operation throughout the tests.

Performance of the tape transport unit was satisfactory throughout the tests, although the 400-cycle ground loops in the test setup made it impossible to check frequency response of the recording circuits.

Operation of the test equipment was satisfactory throughout the tests.

25X1D

The first test run, at 40,000-foot altitude, was interrupted after approximately 4 hours due to a malfunction in the [redacted] circuits. A continuous 4030-cps tone was recorded instead of the digital information. At sea-level conditions, no circuit malfunction could be found and there was no repetition of the trouble during the 25X1D
rest of the test program. Operation of the camera was normal during the first run and approximately 200 feet of film was used. The [redacted] receiver sensitivity appeared to be very poor, especially at the high end of the band. Attenuation of the RG8/U coaxial test cable was checked and found to be considerably higher than in previous tests. With new correction factors established, receiver sensitivity was found to be normal.

The second test run showed good results, with two minor exceptions. The camera occasionally "cleared" itself (i.e., operated continuously) during the run, but operation was normal most of the time. No malfunction was found. Approximately 250 feet of film was exposed during this test run. After 6 hours and 15 minutes of operation, [redacted] became 25X1D
inoperative due to a blown fuse in the +150-volt circuit. The trouble was caused by a loose bolt which caused a short-circuit.

The third and final test run lasted for 7 hours. As indicated above, the camera motor failed early in the test. The -1610-volt power supply

failed after 6 hours of operation, disabling the [redacted] receivers. 25X1D The +120 N supply lost regulation after 4 hours, and the output voltage increased to +126 volts. All other equipment operated normally. The maximum ambient temperature of the environmental tank was 44° C.

3. Test Procedures

The environmental test report for System 4, Serial 104 (CMCC Document No. 162X5.3), described the test equipment used, the physical setup of the system and the test equipment, and the test procedures. The same equipment and procedures were used in the environmental tests of Serial 105, 106, and 107.

4. Detailed Results of Environmental Tests

a. Temperature Tests

Temperatures during the environmental test runs were recorded at four points in the system, in the same manner as previous environmental tests. However, unlike the previous test programs (Serial 104, 105, and 106) the outside ambient temperature remained fairly low throughout the test program for Serial 107. For this reason, the environmental tank temperature also remained relatively low and no temperature problems were encountered. Equipment malfunctions due to high temperature during previous tests occurred only at temperatures considerably higher than those encountered in the normal operating environment of the system.

Throughout the three environmental test runs made with System 4, Serial 107, the recorded temperatures at the four check points remained constant after stabilization at 40,000 feet. For this reason, and because maximum-reading thermometers were used, the temperature graphs included in previous environmental test reports have been omitted from this report. Table 1 lists the maximum recorded temperature at each test point, at altitude, for each test run.

Table 1

Maximum Recorded Temperatures (^{o}C) at Altitude

Test Point	1st Run 27 Feb	2nd Run 2 March.	3rd Run 4 March
Outside ambient	31	31.5	31
Env. tank ambient	33	44	44
Record head	35	44	44
AGC board, Rcvr No. 4	33	44	48
IF board, Rcvr No. 4	51	49.5	64
Power supply	33	54	57

The results of the temperature tests indicate that System 4, Serial 107, will perform satisfactorily in ambient temperature conditions considerably higher than those likely to occur in the operating environment.

b. Power Supply Tests

The power supply voltages were checked at the start of each environmental test run, then rechecked after approximately 1/2 hour of operation and adjusted if necessary. During the tests, a check of the supply voltages was made before and after each set of receiver checks. Table 2 lists the measured voltages for each power supply at sea level and at 40,000 feet for each of the three test runs. The values given for 40,000 feet are those which showed maximum deviation from the sea-level readings.

Table 2

Power Supply Voltages at Sea Level and 40,000 Feet

Power Supply	1st Test Run		2nd Test Run		3rd Test Run	
	Sea Level	40K	Sea Level	40K	Sea Level	40K
ØA	120	117	117	117	117	115
ØB	121	118	117	118	119	117

Table 2

Power Supply Voltages at Sea Level and 40,000 Feet

(Continued)

Power Supply	1st Test Run		2nd Test Run		3rd Test Run	
	Sea Level	40K	Sea Level	40K	Sea Level	40K
ØC	122	119	118	120	120	118
28V	25	27.8	28.2	28.5	27.5	28
-10	-9.9	-10	-9.8	-10	-9.9	-10
-20	-20.1	-17.2	-20.5	-18.0	-22	19.5
-150 Reg	-149	-152	-148	-152	-151	-153
-150	-157	-153	-153	-153	-154	-153
-650	-660	-630	-670	-640	-670	-640
-1610	-1620	-1560	-1660	-1625	-1650	-1610
+400	425	405	410	430	412	425
+ 250	260	251	250	252	252	250
+150	147	149	147	149	149	159
+120 L	120	121	118	120	118	120
+120M	120	122	117	120	118	120
+120N	120	123	118	121	118	127
+120	129	125	124	125	126	125
+55	54.5	52	53	53	54	53
+35	35	36	35	36	35	36
+25	21.5	23	21.5	23	21.5	21.5
+15	14.5	14.9	14.5	14.8	14.6	14.8

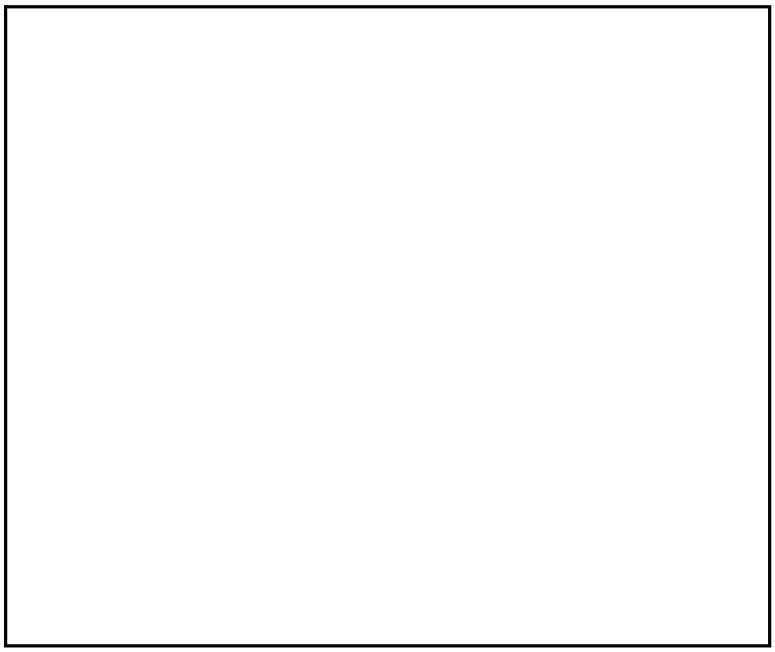
Three minor failures occurred in the power supply circuits during the environmental tests. The -1610-volt supply failed during the third test run due to defective encapsulation of the thermistor assembly. This assembly was replaced after the system was returned to the plant. Also, during the third test run, the +120N supply lost regulation due to a faulty transistor. The +150-volt fuse blew during the second test run, but this

was not the result of a part failure. A loose bolt caused a short circuit in the +150-volt circuit.

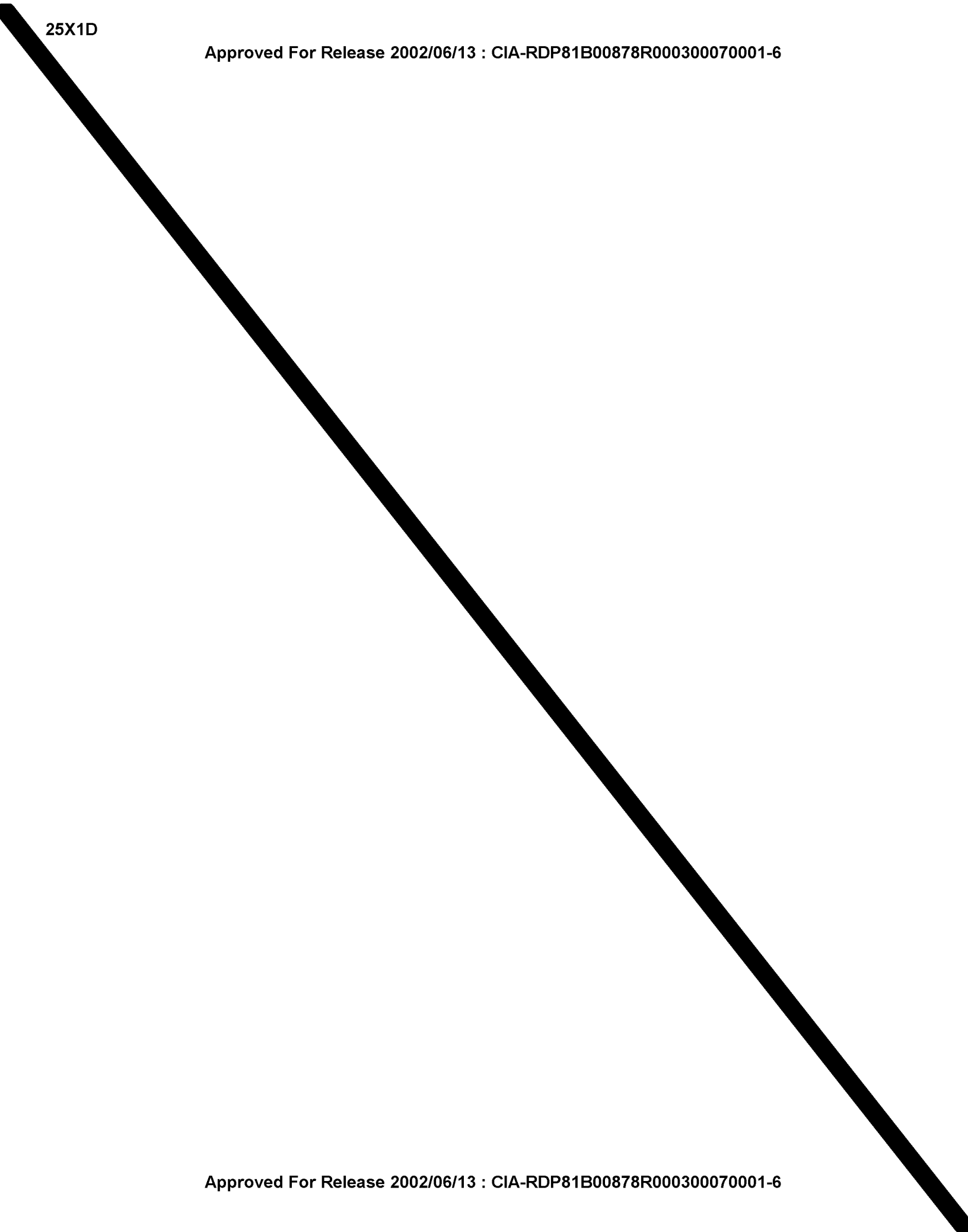
Since the over-all performance of the power supplies was essentially the same as with previous systems, the graphs of power supply voltage deviation as a function of temperature have been omitted from this report.

c. Superheterodyne Receiver Tests

Table 3 shows the average lock-on time for each superheterodyne receiver, within ±2 seconds. Lock-on and frequency-sweep times were measured only once during each test run, since tests of previous systems have shown very little variation as a result of temperature and altitude changes. Average sweep times for each receiver, within ±1 second, are listed in Table 4.



25X1D



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Bandpass responses for the superheterodyne receivers are shown in the graphs of Figures 1 through 8. The average c-w lock-on sensitivity (based on published engineering data and the post-environmental bench check) over the complete spectrum covered by the eight receivers is shown in Figure 9.

d. Programmer and Tape Recorder Tests

Performance of the audio-video programmer and the tape recorder was very good throughout the environmental tests. As indicated in preceding paragraphs, the temperature problems experienced in previous environmental tests were not encountered with Serial 107. Table 6 lists the maximum and minimum values of test data on the programmer and tape recorder during the three environmental test runs.

Table 6
Minimum and Maximum Values of Programmer and Tape Recorder Test Data

Item	Minimum	Maximum
400-cps Frequency	397	400
Capstan Voltage	130	140
Supply Voltage	9.5	12
Take-Up Voltage	8.0	11.5
1000-cps Amplitude	1.2	1.2
3040-cps Amplitude	1.0	1.0
4030-cps Amplitude	3.0	3.4
3000-cps Frequency	2998	3000

e. Camera-Indicator Tests

The only malfunction in the camera-indicator occurred early in the third and final test run. The film magazine take-up motor ran continuously until the film broke. The trouble was traced to

a defective switch in the tension arm assembly. Approximately 450 feet of film was used before the malfunction occurred. A test strip was developed and spot checked, and no loss of frames or rasters was observed.

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Technical Exhibits for System 4

Title	CMCC No.	Copy No.	SAPC No.	Copy No.	Charged to	
Proposal for System 4 Preflight Test Set	1133X5.11	1 of 10 2 of 10 3 of 10 4 thru 10	12789	1 of 3 2 of 3 3 of 3 None	Contracts [redacted] RW retained	25X1A
Receiver Tangential Sensitivity Measurements and Antenna Pattern Measurements for [redacted]	19X5.13	1 of 8 2 of 8 3 of 8 4 of 8 5 thru 8	17196	1 of 4 2 of 4 3 of 4 4 of 4	[redacted] " " " " Contracts RW retained	25X1A
Flight Test Report, System IV Serial 105	162X5.5	1 of 5	DPS 6354	1 of 1	Contracts	25X1D
Environmental Test Report System IV, Ser. 105	162X5.4		6354	1 of 1		25X1D
Environmental Tests System IV, Ser. 106	162X5.7	1 of 15	DPD 0869-59	1 of 1	Contracts	
Cover Letter	151X5.1360	1 of 1	" "	1 of 1	Contracts	
Environmental Tests for System IV Serial No. 107	151X5.1477	1 of 2	DPD 4474-59	1 of 1	Contrcts	
	162X5.8	1 of 7	" "	1 of 1	"	